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DEVELOPMENT AND EVALUATION OF NATURAL ANTI-DANDRUFF SHAMPOO

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ABSTRACT: The objective of this study is to develop and assess an herbal anti-dandruff shampoo that emphasizes safety and efficacy through the use of natural ingredients. Recognizing that healthy, vibrant hair is a key element of beauty, this shampoo is designed to effectively cleanse dirt and dandruff, promote hair growth, enhance lustre, and strengthen and darken the hair. Given the shampoo sector's significant role in the hair care market, it is essential to address the growing concerns regarding the chemical ingredients commonly found in these products, which have been criticized for their potential side effects. The primary aim is to remove harmful synthetic components from the anti-dandruff shampoo formula and replace them with safe, herbal alternatives. This study mixes modern formulation techniques with natural ingredients. The shampoo was prepared using extracts from various herbal substances, including Orange Peel Powder (*Citrus aurantium* Dulcis - Rutaceae), Shikakai (*Acacia concinna* - Fabaceae), Curry leaves (*Murraya koenigii* - Rutaceae), Ginger (*Zingiber officinale* - Zingiberaceae), Aloe Vera (*Aloe Barbadensis* Miller - Asphodelaceae), and Reetha (*Sapindus mukorossi* - Sapindaceae) in different proportions. Several physicochemical tests were conducted to evaluate the shampoos visual appearance, wetting time, pH, stability of contents, dirt dispersion, conditioning performance, and foam stability. The formulated herbal shampoo exhibits a brown color, excellent foam stability, superior cleansing properties, optimal pH, and desirable conditioning effects. These characteristics make it suitable for daily use. However, further clinical studies are necessary to validate its overall quality.

INTRODUCTION: The use of natural extracts and resources for health care and cosmetic purposes was crucial for people in ancient times. As a result, consumer demand has grown for natural alternatives to chemical compounds, particularly in the highly sought-after cosmetic industry. With increasing awareness of the potential side effects and adverse impacts of chemical substances on health, the preference for herbal products has significantly risen.

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To meet these needs and the growing demand for reducing chemical usage, marketing trends are shifting towards cosmetics based on natural ingredients, which are often associated with a healthy lifestyle, both in the food and cosmetic sectors [1].

Hair is a fundamental and essential component of the body, playing a crucial role in overall appearance and often serving as an indicator of health. Among mammals, the presence of hair is a distinguishing feature, contributing to their unique beauty and setting them apart as a distinct class of organisms. Hair serves multiple sensory functions, including providing protection against cold and harmful ultraviolet (UV) radiation. Additionally, the condition of one's hair can have a profound psychological impact, as changes in its growth or

structure can affect self-esteem and perception. The scalp, which is the area of the head where hair grows, is composed of several layers of soft tissue, including sebaceous glands that produce natural oils, and is populated with numerous hair follicles. These follicles are vital for the growth and maintenance of hair. While the texture and shine of hair are commonly associated with the properties of its surface, the overall strength and integrity of hair are largely determined by the health of the hair cortex. This inner structure is responsible for the hair's resilience, elasticity, and ability to maintain its shape. Understanding the complex structure and function of hair is essential in the development of effective hair care products that prioritize both appearance and health [1, 2].

Since hair is a key aspect of one's personality, it is important to address the various challenges people face in maintaining it. Common hair issues include dandruff, which manifests as an itchy, flaky scalp; hair loss, leading to thinning or bald spots; and dryness or brittleness, which can cause split ends and breakage. Moreover, problems such as an oily scalp, frizz, and scalp infections can impact both the health and appearance of hair, making it difficult to manage and style effectively [2, 3].

Dandruff is a prevalent scalp condition that affects nearly half of the global population. This disorder is usually caused by the overgrowth of a yeast-like fungus on the scalp, excessive oil production, or sensitivity to specific hair care products, and it is commonly associated with persistent itching. It has been well-documented that keratinocytes, the primary cells found in the outer layer of the skin, play a significant role in triggering and regulating the immune responses that contribute to the formation of dandruff. The intensity of dandruff symptoms can vary throughout the year, often becoming more severe during the colder winter months when the scalp is more prone to dryness and irritation [4]. Shampoos are a popular cosmetic product chosen by people for daily hair and scalp cleansing. They effectively remove hair oil, dirt, and skin debris from the hair shaft without causing harm to the user. When it comes to addressing hair-related issues, anti-dandruff shampoos are often the preferred choice. Dandruff, a common scalp condition, is caused by a fungus known as Malassezia (Pityrosporum) species. Anti-dandruff shampoos are formulated with fungi static ingredients that help control the growth of this fungus, thereby managing dandruff effectively [2, 3, 5].

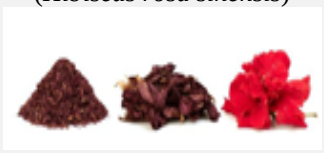
Dandruff can be treated using two Primary Approaches: chemical-based anti-dandruff shampoos and herbal-based anti-dandruff shampoos. Today, there is a wide range of shampoos and scalp treatments available on the market to combat dandruff. Many of these products contain chemicals, which may lead to unwanted side effects such as itching, irritation, hair loss, nausea, headaches, and increased scaling. As a result, herbal formulations, which include natural anti-dandruff plant components, are being considered as alternatives to synthetic shampoos. In traditional Indian medicine, various herbs are used as effective natural antidandruff agents. These include orange peel, bhringraj, amla, ginger, reetha, hibiscus, shikakai, aloe vera, and curry leaves, among others. But formulating cosmetics using completely natural raw material is a difficult task [5]. Formulating cosmetics with entirely natural raw materials is challenging. It involves careful selection and handling of ingredients to ensure safety and effectiveness while maintaining cosmetic properties. Natural ingredients can vary in quality and performance, necessitating thorough testing and quality control. Despite these difficulties, this study aimed to develop herbal shampoo using predominantly natural ingredients, focusing on environmental friendliness [6].

MATERIALS AND METHODS:

Materials: Herbal ingredients, as shown in **Table 1**, such as orange-peel powder, ginger, curry leaves, reetha, aloe vera, hibiscus, and shikakai, are recognized for their effective anti-dandruff properties and are therefore utilized in shampoo formulations [7-9]. Additional ingredients used in herbal shampoo formulation include castor oil, glycerine, sodium lauryl sulfate (SLS), lemon juice, and gum acacia. Each of these components enhances the shampoo's overall effectiveness and performance.

Collection of Materials: Various plant parts were chosen for studying their hair care properties. All the necessary plant materials were sourced from an Ayurveda store.

TABLE 1: HERBAL INGREDIENTS USED IN FORMULATION OF ANTIDANDRUFF SHAMPOO

Herbs	Family	Uses
Orange Peel Powder (*Citrus aurantium* linn) 	Rutaceae	Orange peel powder is used in shampoos for its vitamin C and antioxidant content, which strengthen hair and promote a healthy scalp. It helps remove excess oil and buildup, while its exfoliating properties reduce dandruff and stimulate hair growth. Additionally, it imparts a refreshing fragrance to the shampoo.
Reetha (*Sapindus mukorossi*) 	Sapindaceous	Reetha, or soapnut, is used in shampoos for its natural cleansing properties. It contains saponins, which act as surfactants to remove dirt and oil without synthetic detergents. Reetha is gentle and non-irritating, suitable for all hair types, and helps maintain hair softness and shine.
Hibiscus (*Hibiscus rosa sinensis*) 	Malvaceae	Hibiscus is used in shampoos for its nourishing and conditioning properties. Rich in vitamins and antioxidants, it helps strengthen hair, promote growth, and enhance shine. Hibiscus also has natural moisturizing properties, making it suitable for hydrating and revitalizing all hair types.
Shikakai (*Acacia concinna* linn) 	Fabaceae	Shikakai is used in shampoos for its natural cleansing and conditioning benefits. It gently cleanses the hair and scalp without stripping natural oils, thanks to its saponin content. Shikakai also helps strengthen hair, reduce dandruff, and promote healthy growth, making it suitable for all hair types.
Aloe Vera (*Aloe barbadensis* miller) 	Liliaceae	Aloe vera is used in shampoos for its soothing and moisturizing properties. It helps hydrate the scalp and hair, reducing dryness and flakiness. Aloe vera also contains vitamins and enzymes that promote healthy hair growth and add shine, making it suitable for all hair types.
Ginger (*Zingiber officinale* roscoe) 	Zingiberaceae	Ginger is used in shampoos for its stimulating and invigorating properties. It helps improve blood circulation to the scalp, promoting healthy hair growth and reducing dandruff. Ginger also has natural anti-inflammatory and antimicrobial benefits, which can soothe the scalp and strengthen hair.
Curry Leaves (*Murraya koenigii)* 	Rutaceae	Curry leaves are used in shampoos for their nourishing and strengthening properties. Rich in vitamins and antioxidants, they help promote healthy hair growth, reduce dandruff, and strengthen hair follicles. Curry leaves also have natural antimicrobial properties, which soothe the scalp and improve overall hair health.

Method [10-14]:

Preparation of Extract: All the ingredients, as detailed in **Table 2**, were carefully measured and combined with 50 ml of water in a stainless-steel vessel. The mixture was then heated gradually, allowing the water volume to reduce by one-third. This process concentrated the mixture, enhancing the potency of the herbal components. Following the reduction, the mixture was thoroughly filtered to obtain a clear and purified extract. This clear extract, rich in the active herbal constituents, was subsequently used as the herbal component in the formulation.

TABLE 2: INGREDIENTS USED FOR PREPARATION OF HERBAL EXTRACT

Plant	Part	Quantity
Curry Patta	Leave	2.5gm
Ginger	Root	2.5gm
Orange Peel Powder	Peel	5gm
Reetha	Fruit	5gm
Hibiscus	Leaves	2.5gm
Aloe Vera	Leaves	5gm
Shikakai	Fruit	2.5gm

Formulation of the Herbal Shampoo: The formulation of the herbal shampoo was carried out according to the formula provided in **Table 3**. To begin, 12.5 ml of water was measured and added to a clean stainless-steel vessel. Following this, 10 ml of Sodium Lauryl Sulfate (SLS) was introduced into the vessel and gently mixed with the water. After ensuring the SLS was fully dissolved, 10 ml of 0.1N NaCl was added to the mixture and stirred until it was completely integrated. Next, 5 ml of Acacia was incorporated and allowed to dissolve fully into the solution. Subsequently, 10 ml of the previously prepared herbal extract was added along with 1 ml of glycerin, ensuring thorough and even distribution throughout the mixture. To improve the formulation, 1 ml of Vitamin E oil was added for its antioxidant properties, and 1 ml of lemon juice was included as anti-dandruff agent, natural antioxidant, and chelating agent and maintains the acidic pH in the formulation. Additionally, a few drops of essential oil were incorporated to provide a pleasant fragrance. The entire mixture was then stirred continuously until all the ingredients were well combined. Finally, the consistency of the shampoo was adjusted with additional water if necessary to achieve the desired texture and flow.

TABLE 3: COMPOSITION OF HERBAL SHAMPOO

Ingredients	Quantity
Herbal extract	10 ml
Sodium lauryl sulphate	10 ml
0.1N Nacl	10 ml
Acacia	5 ml
Glycerine	1 ml
Vitamin E capsule	1ml
Lemon juice	1 ml
Essential oil (Castor oil)	q.s
Water	12.5 ml

Evaluation of Herbal Shampoo:

Physical Appearance/visual Inspection: The formulation was thoroughly evaluated through visual inspection for several key attributes, including clarity, colour, odor, foam production, and fluidity. The clarity was assessed to ensure that the shampoo appeared clear and free from any particulate matter. The colour was examined to confirm it met the desired appearance and was consistent with the formulation specifications. The odor was evaluated for its pleasantness and adherence to the intended fragrance profile. Foam production was tested to ensure the shampoo produced a satisfactory amount of lather, indicating effective cleansing properties. Finally, the fluidity of the shampoo was checked to ensure it had the appropriate consistency and ease of application [15, 16].

Determination of pH: A 10% v/v shampoo solution was prepared by diluting the shampoo with distilled water. The pH of this solution was then measured at room temperature using a calibrated pH meter to ensure it fell within the desired range for optimal performance and safety [15].

Percentage of Solid Contents: Four grams of the prepared shampoo were carefully placed into a clean and dry evaporating dish. The initial combined weight of both the dish and the shampoo was recorded precisely. To remove the liquid component of the shampoo, the dish was heated on a hot plate until all the liquid had evaporated. Once the heating process was complete and the shampoo had fully dried, the dish was allowed to cool to room temperature. The final step involved measuring the weight of the solid residues left in the dish to determine percent of solid contents [17, 18].

Wetting Time: The wetting time was assessed by measuring the duration it took for a 1-inch diameter canvas paper disc, weighing 0.44 grams, to become fully submerged. To conduct the test, the disc was carefully placed on the surface of a 1% v/v shampoo solution. A stopwatch was used to record the time elapsed until the disc sank completely into the solution. This measurement provided an indication of the shampoo's ability to wet and penetrate materials [14, 18].

Dirt Dispersion: Two drops of herbal shampoo were introduced into a wide-mouthed Falcon tube that contained 10 ml of distilled water. Following this, one drop of India ink was added to the mixture. The tube was then sealed and shaken

vigorously ten times to ensure thorough mixing. After shaking, the amount of ink present in the resulting foam was evaluated and classified into one of four categories: None, Light, Moderate, or Heavy. This assessment helped determine the extent of foam production and its ability to incorporate the ink [19, 20].

Foaming Ability & Foam Stability: The foaming ability of the herbal shampoo was evaluated using the cylinder shake method. For this assessment, a 10 ml solution of the herbal shampoo was carefully measured and placed into a 100 ml graduated cylinder. The cylinder was then securely covered and shaken vigorously for a duration of 10 minutes. After shaking, the total foam volume was recorded exactly 1 minute later to capture the initial foam formation. To further analyse foam stability, foam volumes were measured at 1-minute intervals over the next 10 minutes. The recorded data revealed that the foam volume remained consistent for approximately 5 minutes, demonstrating a high level of foam stability. This method provided a comprehensive evaluation of the shampoos foaming properties and its ability to maintain foam over time.

Stability Study: The stability of the formulation was examined over a period of four weeks by storing it at a temperature range of 25-30°C. During this time, the formulation was regularly inspected for changes in appearance and physical stability. These evaluations, conducted throughout the month, ensured that any alterations or issues with the formulation's integrity or consistency were noted and assessed [21].

Cleansing Action: The cleansing property of the natural shampoo was thoroughly evaluated by applying it to hair that had not been washed for a full seven days. For this assessment, the shampoo was used to wash the hair of a human subject who had previously applied oil to their scalp 4-5 hours before the washing process. The primary objective was to determine the shampoo's effectiveness in removing accumulated oily dirt and build-up from the scalp. The evaluation focused on how well the shampoo cleansed the hair, addressing both the removal of excess oil and the overall cleanliness of the scalp.

Skin Irritation Test: The prepared herbal shampoo was applied to the skin and left on for a duration of 5 minutes. After this period, the shampoo was thoroughly rinsed off. Following the rinse, the skin was closely observed for any signs of irritation or inflammation. This observation period was critical in assessing the potential for adverse reactions or sensitivity caused by the herbal shampoo, ensuring its safety for use on the skin [17, 22].

Viscosity Evaluations: The viscosity of the shampoos was determined using a Brookfield viscometer, with measurements taken at room temperature. This process involved carefully calibrating the viscometer and then using it to assess the thickness or resistance to flow of the shampoo samples. The viscosity readings provided essential information on the consistency and texture of the shampoos, which are important factors in their overall performance and application [16, 18].

Conditioning Attributes: The conditioning effect of the prepared shampoo, specifically regarding its ability to enhance softness and smoothness, was assessed using artificial hair. This evaluation involved washing the artificial hair with the shampoo to simulate its performance on actual hair. After washing, the hair was examined for improvements in texture, focusing on how well the shampoo conditioned the hair to achieve a softer and smoother feel. This assessment provided valuable insights into the shampoo's effectiveness in delivering the desired conditioning benefits [11, 17].

RESULT AND DISCUSSION: Today's consumers seek shampoos with multifunctional benefits. Many ingredients used in these shampoos are known to meet such demands. Consequently, formulating shampoos with safer, natural, and naturally derived ingredients has become increasingly desirable. The results of all evaluation parameters are presented in **Table 4**.

TABLE 4: EVALUATION STUDY OF THE PREPARED HERBAL SHAMPOO

Sr. no.	Parameter	Observation
1	Physical Appearance	Colour-Brown, Odour-Good, Clarity-Opaque, Consistency-Viscous
2	PH	6.05 to 7

3	Percentage of solid content	20
4	Wetting time	15 sec
5	Dirt dispersion	Good
6	Cleansing action	Good
7	Foam ability	Good
8	Stability study	Stable
9	Skin irritation study	No Irritancy
10	Conditioning attributes	Good
11	Viscosity(cp)	285

The prepared shampoo exhibited excellent characteristics in terms of colour, odor and overall appearance during visual inspection. It also had a desirable viscous consistency.

Most shampoos are formulated to be slightly acidic to neutral to minimize damage to the hair. An optimal pH level helps reduce irritation to the eyes, improves the quality of the hair, and maintains the ecological balance of the scalp. A mildly acidic to neutral pH is desirable because it prevents swelling of the hair cuticles and promotes scalp tightening, which can enhance shine. The pH of the tested shampoo was found to be within the preferred range of 6.05 to 7, indicating that it is nearly desirable for use.

Formulating shampoos with either natural or synthetic ingredients can sometimes result in high solid content. Filtration is a key method used to reduce this solid content to a manageable level. Ideally, good shampoos should contain 20% to 30% solids, as this balance facilitates ease of application and rinsing. Shampoos with insufficient solids may be too watery and wash away too quickly, while those with excessive solids can be difficult to apply and rinse out. The tested shampoo contained 20% solids, which is expected to provide optimal performance and ease of use.

The amount of surfactant in a shampoo directly affects its wetting time. The canvas disc method is a fast, effective, and reliable test for evaluating the wetting capability of a shampoo. A higher concentration of surfactants or detergents generally results in a shorter wetting time, while a lower concentration leads to a longer wetting time. The formulated shampoo demonstrated a maximum wetting time (15 seconds), indicating that it contains a minimal concentration of detergents. Dirt dispersion is a crucial parameter for evaluating the cleansing action of a shampoo. This test helps determine how effectively a shampoo can remove dirt and impurities from the hair. In poor-quality shampoos, ink or dirt tends to remain trapped within the foam, making it difficult to rinse away and leading to re-deposition on the hair. For optimal cleansing, dirt should disperse into the water portion, allowing it to be easily rinsed away without leaving any residue. The prepared shampoo successfully concentrated the ink in the water portion, demonstrating its satisfactory cleaning capability and overall effectiveness in providing a thorough cleanse. This result highlights the shampoos ability to achieve the desired cleansing action, ensuring that impurities are effectively removed during use.

While the main objective of a shampoo is to effectively remove dirt, soil, and sebum, accurately gauging its cleansing power through experimental detergency evaluations can be challenging. Despite these challenges, the cleansing action studies revealed that the final formulation performed well, demonstrating a strong ability to cleanse effectively. This indicates that the shampoo is proficient in achieving the desired level of cleanliness, ensuring that it meets the primary goal of maintaining hair and scalp hygiene.

Customers often prioritize the foaming or lathering properties of a shampoo alongside other qualities, making it a key factor in the evaluation of the product. Although it's well-known that foam generation has little to do with the actual cleansing ability of shampoos, it remains a significant aspect from the consumer's perspective. The developed shampoos demonstrated good foaming characteristics when tested in distilled water, producing stable foams during the evaluation. This indicates that the formulation meets consumer expectations for lather. During the storage period, all properties were carefully monitored, and the formulation maintained their original odor and colour without any significant changes.

This consistency suggests that the formulations are both chemically and physically stable over time, ensuring that they will retain their desired characteristics throughout their shelf life. The stability of these properties not only enhances the product's appeal but also reinforces consumer confidence in its long-term effectiveness and reliability. Additionally, the absence of any noticeable degradation in odor or color indicates that the formulation ingredients were well-chosen and effectively preserved, contributing to the overall success and marketability of the product.

No skin irritation reactions were observed with the formulation, indicating that it is gentle and safe for use. As a result, the prepared formulation was deemed effective and well-tolerated, making it a suitable option for consumers with sensitive skin.

The results clearly demonstrated that the formulated shampoo offers a good conditioning performance. This indicates that the shampoo not only cleanses effectively but also enhance the softness and manageability of the hair, making it a well-rounded product.

Since, Gum Acacia was incorporated into the formulation to enhance thickness, a viscosity of 285 cp indicates that the shampoo achieves an ideal balance between being too thick and too watery. This viscosity level ensures that the shampoo is easy to apply and rinse out.

CONCLUSION: The present study aimed to develop an herbal shampoo designed to reduce dandruff and promote hair growth, offering a safer alternative to conventional products that contain synthetic chemicals. In this research, a natural shampoo was formulated using an aqueous extract of various medicinal plants, including orange peel powder, Reetha, Shikakai, Aloe vera, curry leaves, hibiscus, and ginger. These ingredients are well-regarded in traditional hair care for their beneficial properties.

The primary goal was to create a shampoo that excludes synthetic additives and relies predominantly on natural components. Despite this objective, achieving a completely natural formulation proved challenging. Consequently, the final shampoo contains a small percentage of Sodium Lauryl Sulfate (SLS), specifically 3.75%. While this is significantly lower than the concentrations found in many commercial shampoos, which can range from 10% to 40%, it highlights the compromise necessary to ensure product effectiveness and stability.

A comprehensive series of tests was conducted to evaluate the performance of the formulated shampoo. These assessments focused on various attributes, including foaming ability, viscosity, pH level, and conditioning performance. The results from these evaluations indicated that the shampoo met established quality control standards, demonstrating satisfactory performance in terms of texture, stability, and effectiveness.

However, while the initial findings are promising, further scientific validation is necessary to fully confirm the shampoos overall quality and efficacy. This additional research will help ensure that the formulation not only meets the necessary safety and performance benchmarks but also stands up to long-term use and consumer expectations.

Overall, the study highlights the potential for creating a more natural alternative in the hair care market, though it also underscores the complexities involved in formulating such products. By balancing natural ingredients with minimal synthetic additives, the developed shampoo represents a step toward safer and more environmentally friendly hair care solutions. Future work will focus on refining the formulation and conducting further tests to validate its effectiveness and safety.

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